Technology Opportunity

System Fault Detection and Accommodation

The NASA Lewis Research Center is actively developing system Fault Detection, Isolation, and Accommodation (FDIA) technologies which have been simulated and tested in various aircraft components.

Potential Commercial Uses

Fault Detection, Isolation, and Accommodation techniques developed can be used in various systems that require continuous health-condition monitoring of the system in order to achieve high productivity and to avoid unnecessary system shutdown. Potential applications include the operation of aircraft engines, automobiles, chemical plants, and other automated tasks.

Benefits

- Improves the system operability
- Extends the useful life of the system
- Minimizes maintenance and maximizes perfomance

The Technology

During the past several years, the program has successfully demonstrated several real-time Fault Detection, Isolation, and Accommodation techniques for different classes of faults including sensors, actuators, and components.

In order to accommodate sensor failures, a set of analytically redundant measurements, including all the variables used in the closed-loop control for overall performance, are selected. The selected sensor data generated from the engine model, as well as from the actual engine test data, are then used to train the auto-associative neural network. The neural network operates on the principle of dimension reduction. The network is trained to produce an output vector equal to its original input vector. The redundant sensor information is processed, mixed, and regenerated to provide an estimate of the true measurement. Sensor failure is accommodated by replacing the failed sensor with the estimate for the controller. Simulation results show that the proposed sensor validation scheme can adequately identify the failed sensors and provide reasonable estimates for control purposes.

Model-based fault detection reveals actuator failures. A nominal engine model is used to provide the baseline for the normal operation of the system. An actuator fault model is developed using fault parameters. It is designed so that different fault parameters represent different types of faults of a specific actuator. An on-line estimation algorithm is used to estimate the fault parameters with the real-time input/output data.

Finally, a third fault detection technique which uses the experts' heuristic knowledge can be used to identify the known component faults that are not covered in the previous cases.

Options for Commercialization

One of NASA's missions is to commercialize its technology. The NASA Lewis Research Center's goal is to commercialize its real-time detection techniques described herein. The commercialization of these techniques can be in the form of a software package or hardware implementation. Any company wishing to license these fault detection techniques may do so provided it has a sound business plan with a high potential for success.

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